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Monitoring report on the implementation of city of Tbilisi Sustainable Energy Action Plan

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ENHANCING CAPACITY FOR LOW EMISSION DEVELOPMENT STRATEGIES (EC-LEDS) CLEAN ENERGY PROGRAM

MONITORING REPORT ON THE IMPLEMENTATION OF CITY OF TBILISI SUSTAINABLE ENERGY ACTION PLAN

September 2015

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1. Introduction

1.1 Monitoring Report on the implementation of city of Tbilisi Sustainable Energy Action Plan (SEAP) for 2011-2014

The present document represents the Monitoring Report on the implementation of city of Tbilisi Sustainable Energy Action Plan (SEAP) for the years of 2011-2014.

As it is known, on 30 March 2010 the city of Tbilisi[1] became a subscriber to the EU initiated "Covenant of Mayors"[2] (CoM), thus taking an obligation to reduce the GHG emissions from its territory by at least 20% to 2020[3]. Tbilisi created a precedent which in the following years was shared by other cities of Georgia. Since 2010 up to now addition to Tbilisi Georgia's 9 self-governing cities[4] and 4 municipalities[5] have joined the Covenant of Mayors.

In accordance with the CoM demands, for the efficient implementation of voluntary obligations taken in the frames of CoM Tbilisi in 2011 has developed and submitted to the European Commission the city SEAP[6]. In the preparation of Action Plan the Tbilisi City Hall was assessed by the project "Modern Energy Efficient and Lighting Initiative" executed by the Winrock International under the financial support of USAID. According to the guidelines worked out by the Joint Research Center (JRC) of the European Commission mission[7], the development of SEAP document implies the preparation of Baseline Emission Inventory (BEI) and working out of emissions mitigation Action Plan.

At the initial stage of preparing the mentioned above document in respect to the methodology of baseline inventory assessment and selection of sectors the city of Tbilisi came out with prominent initiative. Considering the strategic vison of country's development it was preconditioned that the country in general and correspondingly its capital are developing intensively, economic activity, GDP and population are growing. Consequently the rising of economy automatically causes the increase in the consumption of resources, among them the energy resources, as the demand on comfort and accordingly its supply are expanding[8]. The decision has been taken on the addition to the JRC methodology of one important component – so called Business As Usual (BAU) Scenario[9], which foresees the growth of energy consumption to 2020 and the development of the city in such a way, that the GHG emissions mitigation policy/measures are not implemented. The mitigation measures presented in the SEAP have been planned just under this scenario relevant to emissions projected for 2020. As

[1] http://www.covenantofmayors.eu/index_en.html
[2] http://www.covenantofmayors.eu/about/signatories_en.html?city_id=1537
[3] https://en.wikipedia.org/wiki/Greenhouse_gas
[4] Batumi, Kutaisi, Telavi, Gori, Akhaltsikhe, Rustavi, Mtskheta, Zugdidi, Poti.
[5] Tianeti, Kazbegi, Bolnisi and Telavi Municipalities
[6] http://www.covenantofmayors.eu/about/signatories_en.html?city_id=1537&seap; http://remissia.ge/index.php/ka/2014-12-09-16-12-09/seaps
[7] http://www.covenantofmayors.eu/IMG/pdf/seap_guidelines_en-2.pdf
[8] The mentioned judgement consonants with the Environmental Kuznec Curve hypothesis, according to which the environmental conditions worsen till to improve not after which the living conditions start to improve not at the price of harming the natural resources, but in contrary under the state of their enhancement, https://en.wikipedia.org/wiki/Kuznets_curve#Environmental_Kuznets_curve.
[9] http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=286

to selected sectors, considering the Tbilisi development priority directions, the street lighting, greening and waste sectors were added to the transportation and buildings sectors. JRC has discussed and accepted this methodological amendment. The methodology applied in the Tbilisi SEAP was lately used by other cities as well.

The strategic vision of the SEAP document[10], which was developed according to the mentioned methodology by the Tbilisi City Hall and approved in March 2011 by the City Council has been both the reduction of GHG emission sources by 2020 and the increase of natural sinks (the green cover). The document also foresees the retaining of city cultural and historic heritage in the process of its implementation, the involvement of stockholders in the planning and execution process, the raising of citizens' awareness and modification of their behavioral norms.

According to the requirements of CoM and the JRC guidelines after developing the SEAP in the span of 2 years the self-governing entity should prepare the Monitoring Report on the implementation of planned measures and submit this Report to JRC, while after 4 years the inventory of GHG emissions must be performed once again concurrently with the monitoring of undertaken measures.

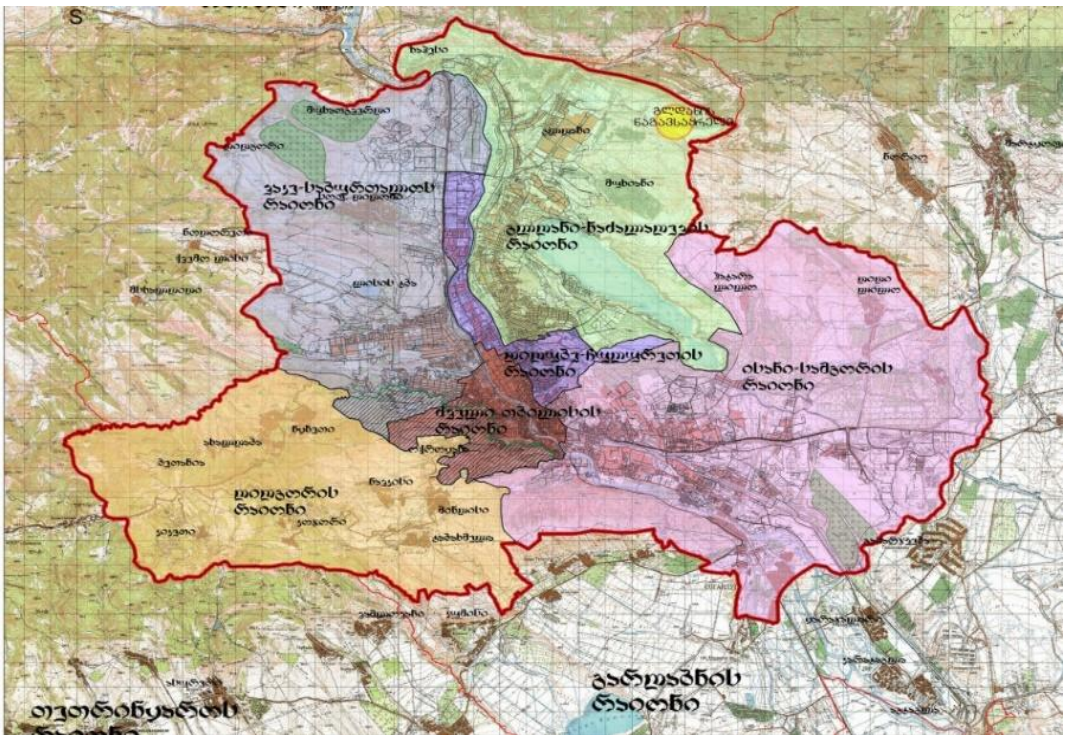
In the present document just the results of these activities are presented. The outcomes of 2014 inventory are presented by sectors, the status of enacting of planned measures and upshots of their conduction are summarized in a separate chapter while the details are given in sections related to individual sectors.

1.2. Trends of Tbilisi development in 2009-2014

Administrative borders

In 2009-2014 the administrative borders of Tbilisi had not changed. According to the Resolution of Georgia's Parliament enacted in 2006[11], the territory of the capital has joined some settlements of Mtskheta and Gardabani Municipalities[12], among them Tabakhmela, Shindisi, Tsavkisi, Kojori, Kiketi, Tskneti, Betania and Akhaldaba settlements.Up to now the Tbilisi administrative territory is divided into 10 districts (Mtatsminda, Vake, Saburtalo, Krtsanisi, Isani, Samgori, Chugureti, Didube, Nadzaladevi and Gldani), which contain 33 different localities, including territories joins under the 2006 Resolution[13].

[10] http://www.covenantofmayors.eu/about/signatories_en.html?city_id=1537&seap
[11] https://matsne.gov.ge/ka/document/view/44278
[12]
[13] https://matsne.gov.ge/ka/document/view/2602734



Picture 1. **Tbilisi administrative borders according to Georgian Parliament 2006 Resolution**

Population

Despite the fact that after 2009 the territorial borders of Tbilisi were not altered, the number of population has increased, once more underlining the growing dynamics and trends of Tbilisi as an urban community. According to official statistics data[14] the population of Tbilisi as for 1 January 2014 equaled to 1 175.2 thousand[15], making the 3.4% rise in comparison to 2009 data with 0.67% mean annual increase, being lower the assumed in the Tbilisi SEAP value of 1.1%.

Table 1. **Dynamics of number of population in Georgia and Tbilisi in 2009-2014 (thousand persons)**

Years	2009	2010	2011	2012	2013	2014
Georgia	4 385.4	4 436.4	4 469.2	4 497.6	4483.8	4490.5
Tbilisi	1 136.6	1 152.5	1 162.4	1 172.7	1171.2	1175.2

Source: National Statistics Service of Georgia

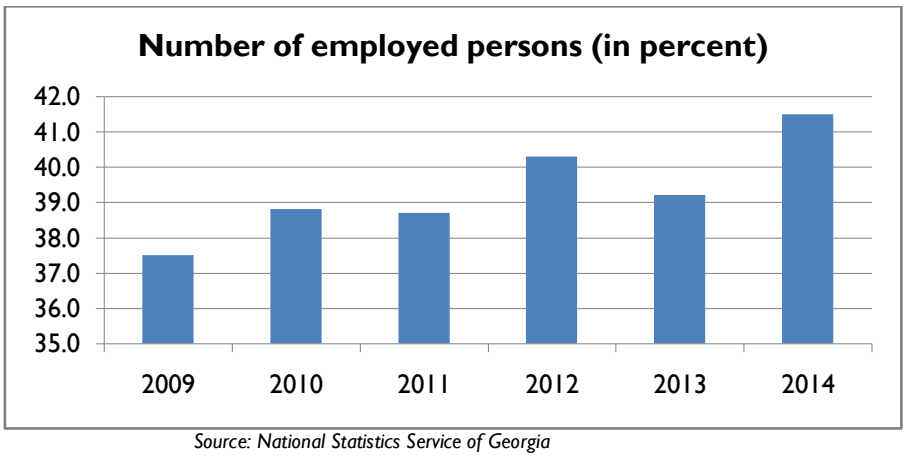
Employment and standard of living

According to official statistics[16], in 2014 41.5% of Tbilisi population were employed giving the 10% in employment compared to 2009 value (37.5%). The dynamics of Tbilisi population employment percentage index in 2009-2014 is presented on Figure 1.

[14]http://www.geostat.ge/?action=page&p_id=151&lang=geo

[15]In November 2014 the population census has been carried out in Georgia, according to preliminary results of which the population of Tbilisi made 1 118 035 persons. However this data was not used in the present Monitoring Report, as its application would cause the necessary of recounting the number of population in the period between the last two censuses, that is not yet competed and the final results will be known after publishing the sequel data (April 2016).

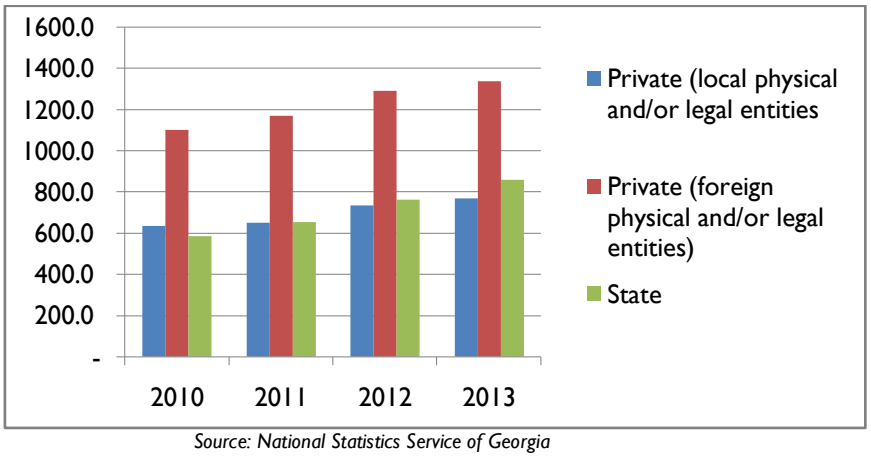
[16]http://www.geostat.ge/?action=page&p_id=142&lang=geo



Source: National Statistics Service of Georgia

Figure 1. **Percentage index of employment in Tbilisi in 2009-2014.**

It has to be noted as well that for the last years the mean monthly salaries of employed persons has increased reflected in the rise of living standard of population. E.g. if in 2011 the monetary and non-monetary means of Tbilisi population were equal to 223 million GEL, by 2014 they amounted to 322.6 million GEL, indicating the 45% growth in this 4-year period[17]. Figure 2 shows the dynamics of the increase of mean monthly salaries during the period of 2010-2013.

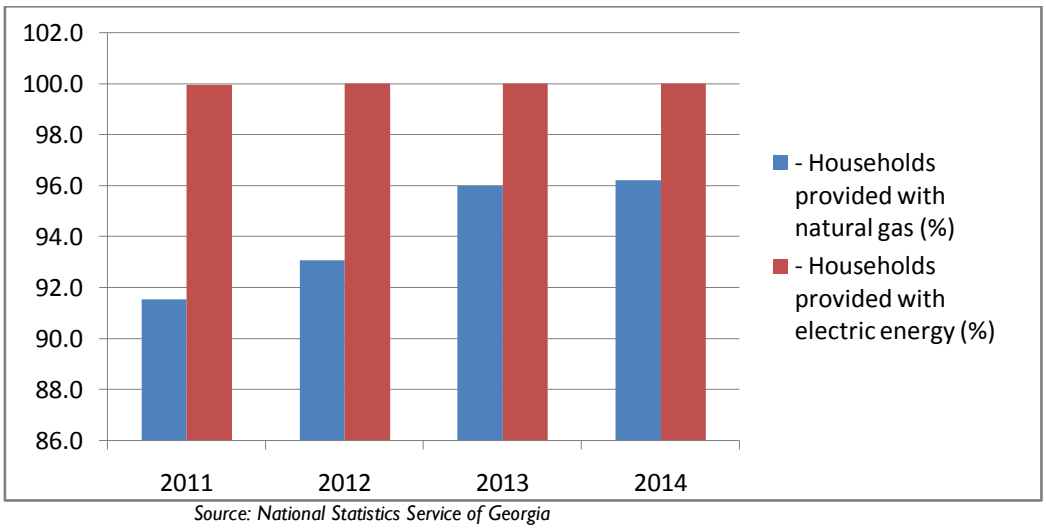


Source: National Statistics Service of Georgia

Figure 2. **Mean monthly salary of employees in Tbilisi in 2010-2013**

Along with the growth of population and incomes the demand on different services and energy carriers has increased, manifested in the rising dynamics of provision with public utilities. E.g. in 2011 91.5% of households in Tbilisi were supplied with natural gas and by 2014 this number has risen to 96.2%, increasing for its turn the consumption of natural gas all over the city. 100% of Tbilisi households are supplied with electricity (Fig. 3).

[17] http://www.geostat.ge/?action=page&p_id=1201&lang=geo



Source: National Statistics Service of Georgia

Figure 3. Household provided with natural gas and electricity in Tbilisi (%) in 2011-2014

The rising technology is observed in Tbilisi transportation and communications turnover, representing one of the important indexes from the standpoint of city energy consumption monitoring. And as to the construction sector, in 2010-2012 the 185% rise has been registered. The details are given in the graphs below (Figure 4 and Figure 5).

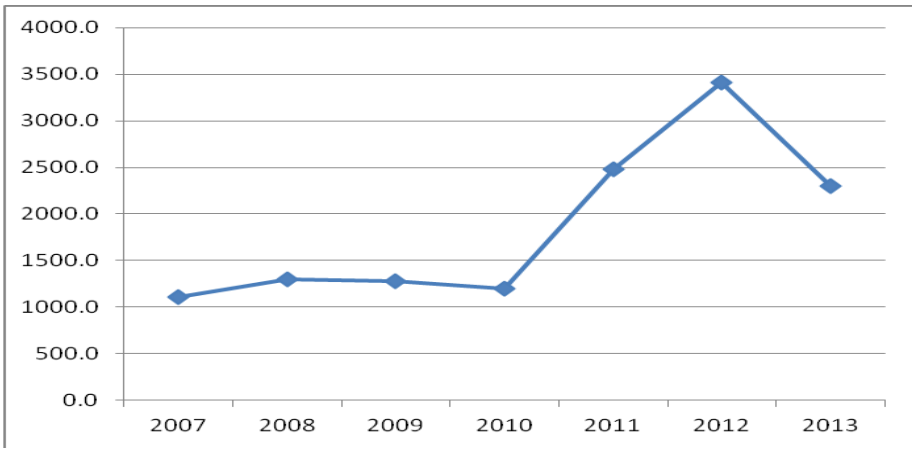


Figure 4. Production generated in the Tbilisi construction sector in 2007-2013 (million GEL)

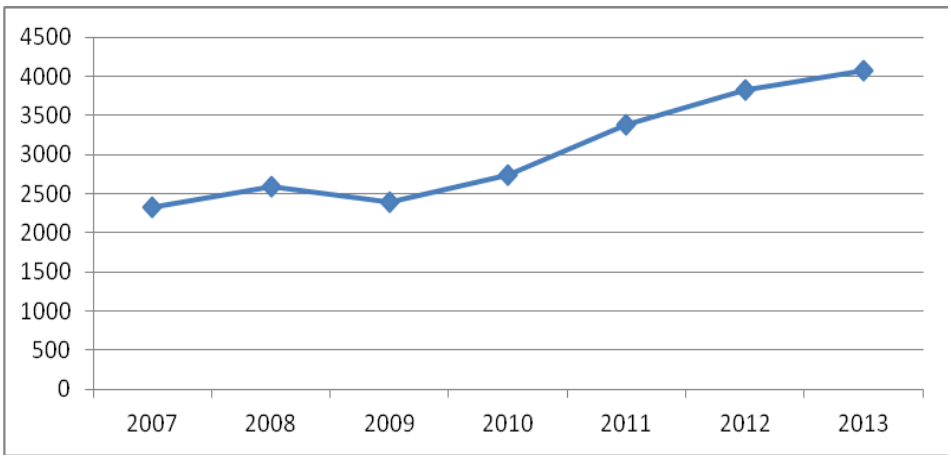


Figure 5. Production generated in the Tbilisi Transport sector and communications in 2007-2013 (million GEL)

The growth dynamics revealed in different sectors of city economy finally has been reflected in the significant growth of city of Tbilisi Gross Domestic Product (GDP). In particular, according to the data of National Statistics Service during the period of 2009-2013 the mean annual growth of GDP by 6.8% has been recorded[18], representing the 2.3% excess rise compared to the assumed in the SEAP value. The details are given in Table 2.

Table 2. The growth of GDP in Tbilisi in 2009-2013

Years	2009	2010	2011	2012	2013	Mean annual growth, %
GDP in current prices, GEL	7 274.3	8 472.6	9 914.3	11 194.2	11 300.9	
Annual growth, %		16%	17%	13%	1%	11.6%
GDP in 2003 fixed prices, GEL	4 887.9	5 242.4	5 602.8	6 261.9	6 366.0	
Annual growth, %		7%	7%	12%	2%	6.8%
Assumption made in Tbilisi SEAP, %		4%	4%	5%	5%	4.5%

All the above mentioned gives a possibility to make some conclusions. In particular, in 2009-2014 as a matter of fact the city of Tbilisi has demonstrated the obvious growth tendency both in the number of population and economic activity as well as in the rise of general standard of life. All these has increased the demand on comfort and different types of resources, among them the energy resources, accompanied by corresponding supplies. Just in this context was going on the implementation of Tbilisi SEAP, connected with the overpassing of several challenges and complications proceed from the fact, that in the process of Tbilisi SEAP development the dynamics of Tbilisi future growth was envisaged at that time and measures were planned relevantly, in spite of energy consumption increase the city managed to attain the % saving of emissions by 2014.

1.3. Governing body of the city of Tbilisi and its priorities

The main responsible body for implementing the Tbilisi SEAP is Tbilisi City Hall[19]. Ensuing from the fact that the Action Plan predicated carrying out of specific measures in different sectors, correspondingly various urban services of the City Hall[20], district administrations, legal Entities of Public Low (LEPLs) and structural units of other type were involved in its execution. The enaction of the plan and its monitoring process is coordinated by the City Hall Economic Policy Urban Service.

In the period of 2009-2014 concerning the institutional arrangement of city self-governing body the important changes were not carried out. Though it should be mentioned that in December 2009 the Tbilisi Architecture Service, being the structural unit of the City Hall, has obtained of the branch, simplify the services, improve the quality and facilitate the introduction of new technologies. In the mentioned body the existing Urban Planning Department was extended by the Urban Development and Management Group, among major functions of which are the urban management of the city and sustainable development that is directly connected with the promotion of successful implementation of the SEAP[21].

[18] During the development of present Monitoring Report the data on Tbilisi GDP were known only till 2013 (including).
[19] http://new.tbilisi.gov.ge/
[20] http://new.tbilisi.gov.ge/Government/40
[21] http://tas.ge/

As to the encouragement by means of adequate financing of enacting planned measures in the SEAP priority sectors, it could be seen from Table 3 that in 2009-2014 such sectors as putting in order of road paving, the development of urban transportation network, etc. were priority sectors in financing. More detailed information about the expenses spent on emissions reduction measures within each concrete sector, is given in relevant Chapters of the Monitoring Report.

Table 3. **Expenses from Tbilisi City Hall budget in 2009-2014**

Expenses from Tbilisi City Hall budget (GEL)						
Years	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Rehabilitation of road surface	110 734.5	135 910.0	47 106.6	67 173.1	61 297.4	48 629.6
Putting in order the transport infrastructure	12 966.5	5 403 300.0	16 052.0	9 697.8	55 389.9	23 752.9
Greening	7 099.2	12 690.0	11 951.6	14 429.7	12 915.3	12 599.8
City lighting	14 394.0	16 575.0	14 330.9	15 568.7	18 079.4	17 642.5

Source: Website of Tbilisi City Hall[22]

As to the strategic documents worked out and approved in this period, the main objective of which is promoting the sustainable development of the city, the Tbilisi land-use General Plan (Resolution #20-105)[23] has been developed and approved in 2014 by the City Assembly. This document determines main parameters of the use of territories (land-use) and construction activities, providing with good amenities, territorial conditions for the environment and cultural heritage realty protection, transport, engineering and social infrastructure, economic development spatial aspects, as well as territorial problems of setting.

In the end of 2014 the Tbilisi Architectural Service in cooperation with the invited experts has analyzed one more basic document concerning the management of capital's spatial and territorial development – "General Plan of Tbilisi Prospective and Development" approved by the Tbilisi City Assembly in 2009. The analysis has revealed that the mentioned document is not valuable, comprehensive and correspondingly, relevant document for providing the spatial development of the capital in the long-run period. In the General Plan of Tbilisi Prospective Development there is no vision of ways to put into effect the priorities, it does not describe the clear pattern of city development, strategic eyesight of what kind of city should become Tbilisi in future. At the same time the intercoordinated schemes of the development of major urban subsystems – transport and infrastructure are not sufficiently integrated. As far as the mentioned document does not reflect the priorities of city development, the government of Tbilisi has considered as an urgent necessity to develop the General Land-use Plan based upon the new challenges and priorities of territorial spatial development and charged the Tbilisi Architectural Service to announce a competition for the renovation of General Plan.

In 2012 under the assistance of the German Government the GIZ has prepared for the Tbilisi City Hall a technical and economic survey aimed at the setting up of Energy Agency at the City Hall. Though the Energy Agency is not created yet, but in the frame of EU program IOGATE the energy efficiency and renewable technologies information – demonstrative center is established in 2015 at the Tbilisi City Hall. In the long-run perspective this center is planned to

[22] http://new.tbilisi.gov.ge/news/1500
[23] https://matsne.gov.ge/ka/document/view/2669598

be transformed into Energy Agency which at least will coordinate the preparation and implementation of SEAPs as well as the development of new project proposals.

The monitoring has been undertaken on some sustainable development criteria as well, among them the impact of SEAP measures on local pollutants. The results are given in the relevant section of presented document.

2. Transport

2.1 Overview of the sector

Since the past centuries Tbilisi is recognized as a center of the South Caucasus Region and its development is one of main priorities and a challenge to the Georgian government. Tbilisi is located in a complex topographical environment of mountains and gorges, on the banks of River Mtkvari, crossing the city and dividing it into two parts. Besides, a number of small tributaries are joining the main river. Parallel to the R. Mtkvari the railway crosses the city. Such environmental conditions greatly affect the city transportation network. Along with the growth of city economy and population the transportation flows are increasing and consequently emerge such serious challenges as the management of traffic jams, air pollution, provision of comfortable public transport system and arrangement of traffic-free zones.

The Tbilisi SEAP in the Transportation sector considers public transport, provide transport and municipality serving vehicle fleet. In 2010-2014 important measures have been taken aimed at the improvement of public transportation services, infrastructure of streets and management of traffic flows. In this subsection general information is given an innovation and tendencies concerning different types of transport, while the detailed information on carried out measures is presented in the Measures section.

Public transport

The public transport in Tbilisi consists of buses, minibuses, subway and cable-cars. The funicular railway is functioning as well. Out of them buses, metro and cable-cars are managed by Tbilisi Transport Company[24], by 100% owned by the Tbilisi City Hall. This Company operates since 1966 and initially managed only Tbilisi metro. In 2009 under the Decree of Tbilisi City Hall municipal buses and associated with them realty in the form of 3 vehicle parks were transferred to this Company. In 2012 the activity area of TTC has widened and a newly constructed Rike-Narikala cable-car was added to its assets.

The company employs about 5 600 persons working in continuous regime to provide residents of Tbilisi and its guests with high quality services and guarantees of maximum safety and comfort in travel. The slogan of TTC is "**Turn the public transport to the attractive and**

[24]Here and further the information source on Tbilisi Transport Company (TTC) and its transportation units is the TTC web-site (http://ttc.com.ge) and Company's annual report (http://ttc.com.ge/index.php?lang_id=GEO&sec_id=142)

real alternative to the motor-car", being in full compliance with the SEAP position in Transportation sector.

Picture 2. **Kinds of public transport under the Tbilisi Transport Company**

In 2009-2014 the share of Tbilisi population using the public transport has increased significantly. In particular, in 2014 the number of passengers transported by buses has increased by 113% compared to 2009, passenger turnover of shuttle mini-buses has grown by 40% and that of subway by 25%. At the same time a new cable-car was added, which has transported more than a million passengers in 2014. Detailed information on the number of transported travelers is given inTable 5.

In September 2012 a measure planned under the Tbilisi SEAP has been implemented, according to which the travel tariff reduction system was introduced, allowing the passengers of metro or the bus using plastic cards to take a trip with any transfers for 90 minutes. Correspondingly, as there a less long routs, the number of transfers has risen causing significant increase in passenger turnover, not related with the addition of new passengers. Subtracting from the total turnover passengers engaged in transfers we get 68% increase instead of 113% rise (Table 5). In recent years the free of charge categories have been adopted as well. In 2012 the advanced controllers system has been introduced that helped the company to improve the registration of passengers, being one of the causes of passenger turnover growth.

Unfortunately, despite the increased passenger turnover the number of buses and amount of consumed fuel have not grown. In contrary, the number of buses has decreased. Large DAF type buses were commissioned/written off in the beginning of 2011 due to their absoluteness and technical despair, but the bus fleet has not been filled up, causing the shortening of routs. Main features of Tbilisi bus fleet in 2009 and 2014 are shown inTable 6.

Regrettably, in view of having absolute and curtailed fleet of buses the quality of service offered to passengers is far from desired yet. The decrepitude of vehicles, uncomfortable and overloaded conditions on lines remain the main problem to the public transport. It's impossible to achieve high standard of services without the renovation of vehicles fleet and relevant infrastructure. Ensuing from this the company in cooperation with the City Hall is working on the identification of sources to finance the purchase of new buses in the nearest future.

To provide the safety of public transportation sufficient attention is being paid to the maintenance of buses, quality of purchased spare parts. Drivers employed by the Company are trained before the hiring and the state of their health is annually controlled to provide its compliance with regulations. The bus dispatching office conducts permanent monitoring and

control on buses operating in the city. Special internal hot line is operating for drivers. In case of emergency situations dispatchers are ready to respond efficiently.

In 2009-2014 a number of measures were taken to rise the comfort and improve the safety in Tbilisi subway. In the frame of carriage fleet renovation program the modernization of entire rolling-stock of the Company has been completed to 2015 by the company's special repairs plant. This work included both the major repairs of carriages and the installation of modern systems, replacement of internal and external equipment, fitting out of locomotive-driver's cabin with modern control panel. Table 8illustrates energy consumption in the Tbilisi metro.

Since 26 June 2012 the Tbilisi public transport network got a new cable-car route joining the Rike Park with the Narikala Fortress. The cable-car line is constructed according to international standards and complies with European safety norms. Its length 500 m and consists of 7 cabins covered with glass and adapted to disabled persons. In 2014 the cable-car has operated for 4 227 hours and consumed 219 800 KWh electric energy.

Along with transportation service the TTC develops information services as well. All bus stations are equipped with digital displays allowing passengers to define exactly the time of suitable bus arrival. The SMS and Internet services are available at the same time. In 2013 up to one million SMS services stops were provided, 46 188 trips were planned and 1 800 bus stops were checked. The information on subway and bus routes, stops and schedules are integrated in the Google Transit System.

As to the shuttle mini-buses, in 2011 a tender has been carried out to select companies operating on the territory of Tbilisi. As a result of this competition the number of mini-buses running in the city has decreased and the routes were specified. The requests stated in the tender concerned the technical condition of the mini-bus, comfort, professional level of drivers, safety, etc. 4 companies were winners of the competition and in 2011 the LLC "Tbilisi Mini-bus" was set-up to manage these 4 companies, which obtained the license to transport passengers within the limits of Tbilisi for the 20-year period.

Since 15 July 2011 Tbilisi population is served by yellow "Ford" mini-buses which are much more comfortable than the mini-buses used before. Initially the mini-buses were requested to provide high standards of comfort (air conditioning) and safety (prohibition of standing travel), but later on the growing passenger turnover and lack of vehicles resulted in the overloading of mini-buses and consequent lowering of demanded standards. In mini-buses both the traditional and plastic card systems of payment are functioning, as well as the use of integrated card, applied in other public transport. Mini-bus routes could be found at the web-site: http://tm.ge//routes/site.php.

Main features of mini-bus fleet in 2009 and 2014 are shown inTable 7. As it could be seen from this Table in recent years the number of shuttle taxis has decreased, though the consumed fuel per one bus has increased. At the same time the shuttle taxis operating on natural gas have appeared. Overall consumption of fuel is reduced.

In the end of 2012 the Telavi funicular has resumed functioning. Its cable railway connects the Chankadze Street with the Mtatsminda Park. For many decades the funicular has been a

prominent sight for local population and tourists. The new cable car delivers 60 people in 3 minutes from 460 m up to 727 m a.s.l. The length of the railway equals to 501m. Two carriages are operating simultaneously with function in midway. Both of them are equipped with a number of safety systems providing accidental stopping of the carriage is case of any emergency. In 2014 the tram has served 639 387 passengers consuming in total 645 198 KWh of electricity.

Private transport

The private transport in Tbilisi consists of passenger cars running in the city, taxis (mainly being in private ownership) and commercial vehicles. The rapid development of city economy causes significant increase in the number of all three types of motor-cars. In particular, in the period of 2010-2014 the number of passenger cars (including taxis) has increased by 35% and that of commercial vehicles and trucks – by 43%.

During the mentioned period a number of measures have been undertaken aimed at optimizing the transportation network and improving the road infrastructure. These measures include the arrangement of traffic lights control system, providing the traffic management and setting up of so called "green waves".

At the same time new roads and tunnels were constructed to provide the unloading of traffic in the Streets, road diving borders have been arranged, etc. However, in spite of these measures the traffic in Tbilisi remains significantly overloaded.

The Tbilisi transport junctions, where the traffic is impeded in rush hours are as follows: Liberty Square, Saakadze streets, crossroads of Beijing and A. Kazbegi streets, as well as:

- Crossroads of Beijing and Tsintsadze streets;
- Overpasses at the Square of Heroes;
- Crossroads of Tamarashvili and University streets;
- Crossroad of Kartozia and Bakhtrioni – Tamarashvili connecting streets;
- Right embankment section from Baratashvili Bridge to Queen Tamar Bridge;
- Melikishvili Square;
- Queen Tamar Avenue;
- Crossroads of Marshal Gelovani Avenue and Sarajishvili streets;
- Vicinities of Metro Station "Akhmeteli";
- Crossroads of Sheshelidze and (ვერამოვიკითხე) streets;
- GelovaniAbenue;
- Javakheti Street.

The severe flood and debris-flow of 13 June 2015 seriously damaged the newly constructed ChabuaAmirejibi Freeway (SEAP Measure G 2.2) which has not reconstructed yet. The primary goal of this freeway construction was the unloading of Chavchavadze and Beijing streets and hence its fall into disuse will cause the overloading of these streets again.

It should be noted that the hampering of traffic often is caused by the low culture of traffic participants. Both drivers and pedestrians are frequently violating the traffic rules, that negatively affects the movement of transport.

The parking of vehicles at the territory of Tbilisi since 2007 is managed by the LLC "City Park" (CTP). Up to now this is an only company to be responsible for the perfection of parking system in the city. In 2015 the Tbilisi City Hall started negotiations with the company on the banning of parking at the pavements and admission of other companies in this activity, though to the moment of compiling this report the agreement is not achieved.

The parking fee is determined by the Tbilisi government and equals to:

- 50 GEL per annum
- 25 GEL per 6 months
- 4 GEL per 1 week.

The cost was increased in 2010 (till then the annual tax made 25 GEL) accompanied by the expansion of parking places. The dynamics of parking places in Tbilisi shown inTable 4.

Table 4. Number of parking places in Tbilisi

Year	Number of parking places	Among them special places for disabled persons
2010	16 091	102
2011	34 410	107
2012	36 225	314
2013	33 501	308
2014	33 029	324

As it is seen from the Table, since 2009 number of parking places has increased, but in last years the number has again decreased. This was caused both by the unloading of certain streets and by allowing pedestrians to move freely at the pavements.

One of special features of transport sector in Tbilisi is the significant number of private taxis. Official data on their number is unknown. According to experts assessment the number of taxis in Tbilisi to 2015 exceeded 70 000 and notable increased since 2009. This is caused by the fact that today any person can alter the private car into the taxi without any restrictions from the state. Any driver having the "B" category license can be engaged in the "taxi business". Regulations do not stipulate any form of professional training and even the yellow stencil could be bought by any driver for 40 GEL and more.

In the Tbilisi SEAP, prepared in 2011 no information was provided on the movement of taxis in 2009 as it was not available at that time. Therefore taxis were aggregated with private vehicles and they were assessed by joint questioning. By 2014 the questioning of taxi drivers was undertaken by the EC-LEDS project, aimed at the determination of fuels, fuel consumption and run of the taxis. As to the number of taxis, it was estimated by the expert judgement and numbering of taxis running in the streets because there is no relevant statistics. As a result it was revealed that the majority of taxis (87%) is fueled by natural gas and their age varies in the

range of 10-20 years (78%). 16% of cars are older than 20 years and only a small portion is relatively new cars. Other parameters are given inTable 11.

Also in 2014 the EC-LEDS project has conducted the questioning of population in 10 cities of Georgia, including Tbilisi. It was derived as a sequel that in 2014 25% of Tbilisi population owned the automobile, suggesting the same data from the Ministry of Internal Affairs. Most widespread types of cars appeared to be Opel, BMW, Mercedes and Toyota. 90% of cars are 10 years of age and more and the majority (57%) is produced in 1995-2005.

Among the fuels gasoline is the most usable fuel (71.1%). The share of natural gas has significantly grown from 2009 to 2014. In that year its share made 26.3%. The diesel fuel is used by only 2.6% of private cars. According to respondents 80% of their run goes to urban areas, where their annual distance coverage is about 10 092 km. Other features are given in Table 11.

The parameters of private passenger cars in 2009 and 2014 are compared in Table 12.

As to the private commercial vehicles, the information on the number of trucks registered in Tbilisi is available in the Ministry of Internal Affairs, though there is no data on their annual run and consumed fuel by types. Hence the assessment are the same, as they were assumed for 2009. This sector requires the substantial additional analysis. The comparison of commercial cars' parameters in 2009 and 2014 is presented in Table 10.

The daily flow of transport coming into Tbilisi from other regions of Georgia should be the subject of additional survey as well.

Municipality owned vehicle fleet

In 2009 at the balance-sheet of Tbilisi City Hall (including district divisions) in total 304 motor-cars were registered. In 2011 the cars were substituted and the City Hall has purchased 210 new vehicles, the majority of which were small-engine cars consuming lower amount of fuel (mainly KIA PICANTO 1.0). As a result the consumption of fuel has decreased and emissions were lowered. Information on vehicle fleet serving the City Hall is given inTable 14, while the measure of car substitution is discussed in detail when describing the relevant measures.

1.1. Parameters under monitoring and methodology

The Tbilisi Transport sector has been monitored according to following parameters:

1. Passenger turnover of public transport;
2. For all vehicle types (bus, mini-bus, private passenger cars, private commercial, municipality-owned vehicles):
    - Number of vehicles by fuel consumed;
    - Average run by fuel consumed as well;
    - Average consumption of fuel per 100 km by fuel types.

On the basis if this information the annual consumption of fuel (by fuel types) and amount of emissions is being calculated;

3. For the electric passenger transport (metro, aerial cable-ways, funicular tram):

    - Electric energy and other fuels (if used) consumption.

Using this information the amount of emissions is described in Appendix A.

The methodology for calculating the amount of emissions is described in Appendix A.

At the same time the information has been collected on the measures implemented, described in the relevant sections of present report. As to the calculation of reduced by these measures emissions, the assumptions used in Tbilisi 2011 SEAP were applied, including the presumptions concerning 2014.

Passenger turnover of public transport

The passenger turnover of public transport has increased significantly. As it has been explained earlier, this is partly caused by the shortening of routs and introduction of 90-minute free transfers. The data on passenger turnover is presented in Table 5.

Table 5. Passenger turnover of public transport in 2009 and 2014 by transport types

Passenger turnover (passenger per annum)	2009	2014	Increase (%)
Bus	56 900 000	121 261 180	113
Mini-bus	113 800 000	158 916 505	40
Metro	78 300 000	98 981 378	26
Cable car	0	1 026 648	100
Funicular	0	639 387	100
Total	**249 000 000**	**380 825 098**	**53**

Sources: 2009 data (except metro) – The Tbilisi SEAP, 2014 data – Transportation Service of Tbilisi City Hall.

Subtracting in public transport passengers, using the 90-minute transfer (accounting their one trip by two transports as a one trip), their number making 21% of subway and bus passengers, the turnover increase will become 34.4% instead of 53%.

Public transport-buses

In public transport the number of buses in Tbilisi has notably decreased. The annual run and amount of consumed fuel are reduced as well, finally resulting in the lessening of emissions (Table 6).

Table 6. Features of Tbilisi bus fleet, fuel consumption and emissions

Parameter	2009	2014	Increase (%)
Number of buses (all diesel fueled)	934	679	-27
Annual run (m/vehicle)	62 527	59 289	-5
Average fuel consumption by 1 diesel powered bus (l/100km)	34	24	-29
Total fuel consumption – diesel (l)	19 981 054	9 821 054	-51

Total fuel consumption – diesel (MWh)	209 351	102 900	-51
Total emissions – diesel (t CO_2 eq.)	55 400	27 230	-51

Source: 2009 data the Tbilisi SEAP, 2014 data – Transportation Service of Tbilisi City Hall

The Table shows that in public transport subsector the emissions from buses are reduced by 51% compared to 2009.

Public transport – mini-buses

In case of shuttle taxis the number of vehicles and the run are reduced as well, though the fuel consumption on 100 km per one vehicle has risen and 65 mini-buses operating on natural gas are introduced. All these results in 21% cutback of emissions in comparison with the 2009 data (Table 7).

Table 7. Features of Tbilisi mini-bus fleet, fuel consumption and emissions

Parameter	2009	2014	Alteration (%)
Number of vehicles by fuel type			
Operating on diesel	2 621	1 562	-40
Operating on natural gas	0	65	100
Total	2 621	1 627	-38
Annual run (km/vehicle)	80 300	77 127	-4
Average fuel consumption of 1 vehicle on diesel (l/100 km)	12	16	33
Average fuel consumption of 1 vehicle on natural gas (m^3/100km)	-	19	100
Total fuel consumption – diesel (l)	25 255 956	19 275 498	-24
Total fuel consumption – natural gas (m^3)	-	952 514	100
Total fuel consumption – diesel (MWh)	264 619	201 959	-24
Total fuel consumption – natural gas (MWh)	-	8 888	100
Total energy consumption (MWh)	264 619	210 847	-20
Total emissions – diesel (ton CO2 eq.)	71 768	54 774	-24
Total emissions – natural gas (ton CO2 eq.)	-	1 821	100
Total emissions (ton CO2 eq.)	71 768	56 594	-21

Source: 2009 data – the Tbilisi SEAP, 2014 data – Transportation Service of Tbilisi City Hall

Electric Transport

Compared to 2009 the number of metro wagons/carriages has not changed and the carriage fleet equals to 195 units. At present 149 wagons are in operation (among them 145 renovated). Energy consumption in 2009 and 2014 by the metro and cable car is given. Emissions are calculated using emission factor defined by two different methods. First of them is the SEAP value computed under the CDM methodology, equal to 0.399995 ton of CO_2 eq. per each MWh, and the second average emission factor computed annually for the country as the ratio between total GHG emissions from the energy generation sector and total amount of generated electric energy. The calculation of this factor is shown in the Annex A. The energy consumption by Tbilisi metro is given inTable 8.

Table 8. Tbilisi metro wagon fleet, fuel consumption and emissions

	2009	2014	ცვლილება, %
Total carriage fleet (unit)	195	195	0
Annual run of metro carriages, total (km)	21 460 800	20 640 643	-4
Total fuel consumption – gasoline (l)	38 148	0	-100
Total fuel consumption – diesel (l)	83 322	0	-100
Total consumption – electric energy (MWh)	62 949	64 284	2
Total fuel consumption – gasoline (MWh)	352	0	-100
Total fuel consumption – diesel (MWh)	873	0	-100
The energy consumption (MWh) - gross total	64 174	64 284	0.2
Total emissions – gasoline (ton CO2 eq.)	88	0	-100
Total emissions – diesel (ton CO2 eq.)	231	0	-100
Total emissions – electricity (ton CO2 eq.) by CDM factor	25 176	25 622	2
Total emissions – electricity (ton CO2 eq.) by the average factor	5 619	6 694	19
Total emissions (ton CO2eq.) – by CDM factor	25 495	25 622	1
Total emissions (ton CO2eq.) – by the average factor	5 938	6 694	13

Source: 2009 data – the Tbilisi SEAP, 2014 data – Tbilisi Transport Company (TTC).

Despite the slight decrease in the annual run of carriages, the energy consumption by the metro has increased, that is caused by the growing number of passengers transported. The metro wagons operate on the direct current (4 engines in one train) which is featured by the rising energy consumption with the increase of loading, i.e. the more is number of passengers and, correspondingly, the loading, and the more is the energy, consumed by engines.

Electric energy consumption and relevant emissions from cable-car and funicular are shown inTable 9 and Table 10.

Table 9. **Electricity consumed by the cable-car and corresponding emissions**

Parameter	2014
Total consumption – electricity (MWh)	220
Total emissions (t CO2 eq.) – by CDM factor	88
Total emissions (t CO2 eq.) – by the average factor	23

Source: Tbilisi Transport Company

Table 10. **Electricity consumed by funicular and corresponding emissions**

Parameter	2014
Total consumption – electricity (MWh)	645
Total emissions (t CO2 eq.) – by CDM factor	258
Total emissions (t CO2 eq.) – by the average factor	67

Source: LLC "Tbilisi Park".

Private passenger cars and taxis

Information concerning private cars and taxis including their numbers, obtained in 2014 under questionings, is compiled inTable 11.

Table 11. **Features of private passenger cars and taxis, fuel consumption and emissions in 2014**

Parameter	2009	2014	Alteration %
Number of vehicles by fuel type			
Gasoline powered	149 580	5 638	155 218
Diesel powered	17 165	3 993	21 158
Natural gas powered	78 468	60 369	138 837
Total	**245 213**	**70 000**	**315 213**
Average annual run (km/vehicle)	10 100	56 702	
Average gasoline consumption by 1 car (l/100 km)	11	6	
Average diesel consumption by 1 car (l/100 km)	10	7	
Average natural gas consumption by 1 car (l/100 km)	13	7	
Total fuel consumption – gasoline (l)	166 183 302	19 712 345	185 895 647
Total fuel consumption – diesel (l)	17 336 559	15 050 642	32 387 201
Total fuel consumption – natural gas (m^3)	99 066 052	226 211 345	325 277 397
Total fuel consumption – gasoline (MWh)	1 531 345	181 645	1 712 990
Total fuel consumption – diesel (MWh)	181 629	157 680	339 309
Total fuel consumption – natural gas (MWh)	924 341	2 110 678	3 035 019
Total energy consumption (MWh) – gross total	**2 637 315**	**2 450 003**	**5 087 318**
Total emissions – gasoline (t CO2 eq.)	381 257	45 224	426 480
Total emissions – Diesel (t CO2 eq.)	48 068	41 730	89 798
Total emissions – natural gas (t CO2 eq.)	189 344	432 355	621 699
Total emissions (t CO2 eq.)	**618 668**	**519 309**	**1 137 977**

Resulting number of vehicles, fuel consumption and emissions are compared with parallel values in 2009 (Table 12).

Table 12. **Number of private passenger cars (including taxis) fuel consumption and emissions in 2009 and 2014**

Parameter	2009	2014	Alteration %
Number of vehicles by fuel type			
Gasoline powered	221 372	192 280	-13
Diesel powered	10 253	22 065	115
Natural gas powered	1 562	100 868	6358
Total	233 187	315 213	35
Average annual run (km/vehicle)	12 775	10 100	-21
Average gasoline consumption by 1 car (l/100 km)	12.00	11.00	-8
Average diesel consumption by 1 car (l/100 km)	10.00	10.00	0
Average natural gas consumption by 1 car (l/100 km)	10.42	12.50	20
Total fuel consumption – gasoline (l)	339 363 276	213 623 002	-37
Total fuel consumption – diesel (l)	13 098 208	22 285 559	70
Total fuel consumption – natural gas (m^3)	2 079 233	127 346 052	6025
Total fuel consumption – gasoline (MWh)	3 127 413	1 968 649	-37
Total fuel consumption – diesel (MWh)	137 236	233 496	70
Total fuel consumption – natural gas (MWh)	19 753	1 188 304	5916
Total energy consumption (MWh) – gross total	**3 284 402**	**3 390 450**	**3**
Total emissions – gasoline (t CO2 eq.)	778 565	490 092	-37

Total emissions – Diesel (t CO2 eq.)	36 317	61 790	70
Total emissions – natural gas (t CO2 eq.)	4 046	243 395	5916
Total emissions (t CO2 eq.)	**818 927**	**795 277**	**-3**

Source: 2009 data – the Tbilisi SEAP, 2014 data – total number of vehicles – Ministry of Internal Affairs, other parameters EC-LEDS questionings.

As it is seen from the Table, emissions from this subsector have grown by 39%, that, presumably, is caused by remarkable enlargement of taxi fleet. The significant increase in the number of gas-fueled vehicles is also to be mentioned (the gasoline – powered cars are transferred into gas fuel).

In 2014 the motor bikes in Tbilisi have been accounted as well, the total number of which, according to the Ministry of Internal Affairs register, made 2 737 units.

Private commercial vehicles

The survey on private commercial vehicles has not been carried out and only the registration data are available. Hence figures on the run and fuel consumption are taken the same as in 2009.

Table 13. **Features of private commercial vehicles, fuel consumption and emissions**

Parameter	2009	2014	Alteration %
Number of vehicles by fuel type			
Diesel powered	15 710	21 285	35
Natural gas powered	-	1 120	100
Total	15 710	22 405	43
Annual run (km/vehicle)	30 923	30 923	0
Average diesel consumption by 1 car (l/100 km)	25	25	0
Average natural gas consumption by 1 car (l/100 km)	-	20	100
Total fuel consumption – diesel (l)	121 450 024	164 547 081	35
Total fuel consumption – natural gas (m^3)	-	6 928 298	100
Total fuel consumption – diesel (MWh)	1 272 490	1 724 038	35
Total fuel consumption – natural gas (MWh)	-	64 650	100
Total energy consumption (MWh) – gross total	1 272 490	1 788 688	41
Total emissions – Diesel (t CO2 eq.)	336 737	456 229	35
Total emissions – natural gas (t CO2 eq.)	-	13 242	100
Total emissions (t CO2 eq.)	336 737	469 471	39

Source: 2009 data – the Tbilisi SEAP, 2014 data – total number of vehicles – Ministry of Internal Affairs, other parameters-experts assessments and 2009 Tbilisi SEAP

Tbilisi City Hall serving vehicles

The data on the number and fuel consumption of vehicles providing the Tbilisi City Hall is presented in Table 14.

Table 14. **Features of Tbilisi City Hall serving vehicles, fuel consumption and emissions**

Parameter	2009	2014	Alteration %
Number of vehicles by fuel type			
Gasoline powered	164	258	57

Diesel powered	140	11	-92
Total	304	269	-12
Annual run (km/vehicle)	33 600	47 113	40
Average gasoline consumption by 1 car (l/100 km)	14	6.50	-54
Average diesel consumption by 1 car (l/100 km)	9	7.85	-16
Total fuel consumption –gasoline (l)	771 456	790 093	2
Total fuel consumption – diesel (l)	438 000	40 663	-91
Total fuel consumption – gasoline (MWh)	7 109	7 281	2
Total fuel consumption – diesel (MWh)	4 589	426	-91
Total energy consumption (MWh) – gross total	**11 699**	**7 707**	**-34**
Total emissions – gasoline (t CO2 eq.)	1 770	1 813	2
Total emissions – diesel (t CO2 eq.)	1 214	113	-91
Total emissions (t CO2 eq.)	**2 984**	**1 925**	**-35**

As it could be seen from the Table, the fuel consumption by serving vehicles has decreased, that is caused by carrying out the adequate measure in 2011, consisting of the substitution of existing vehicles with smaller engine powered cars. The total number of replaced in 2011 automobiles made 210.

2.2. 2014 Inventory of Transportation Sector and Correspondence of GHG Emissions With Baseline Scenario

Table 15demonstrates the aggregated 2009 and 2014 data on energy consumption and GHG emissions from Tbilisi Transport sector. As it is clear from these data, the energy consumption has increased by 43% while the emissions grew only by 32%. This discrepancy is caused by the rise in the share of natural gas powered vehicles.

Table 15. Energy consumption and GHG emissions from the Tbilisi Transport sector in 2009 and 2014.

Category of transport	Energy consumption (GWh)			Emissions (Gg CO2 eq.)		
	2009	**2014**	**Change, %**	**2009**	**2014**	**Change, %**
Municipality serving vehicles	11.7	7.7	-34	3.0	1.9	-35
Public transport						
Buses	209.4	102.9	-51	55.4	27.2	-51
Mini-buses	264.6	210.8	-20	70.0	55.3	-21
Electric transport	64.2	65.5	2	25.5* (5.6)**	26.1* (6.8)**	3
Total	**538.1**	**378.3**	**-30**	**150.9**	**108.3**	**-28**
Private transport						
Passenger cars (including taxis)	3284.4	5087.3	55	818.9	1138.0	39
Commercial transport	1272.5	1788.5	41	336.7	469.5	39
Motor-bikes		45.4	100		11.3	100
Total:	4556.9	6921.3	52	1155.7	1618.8	40
Transport – gross total	**5106.7**	**7308.2**	**43**	**1309.6* (1289.7)****	**1729.3* (1710.0)****	**32**

* Calculated using electricity CDM Factor
** Calculated using electricity averaged Factor

According to baseline scenario the emissions increase to 2014 was projected up to 1 830 Gg. The baseline scenario has been updated with the actual data on the number of population and GDP, as well as by addition of motor-bikes category, not included in the 2009 plan. The emissions in the renovated baseline scenario made up 1 813 Gg and consequently the emissions are decreased (Fig. 1).

Figure.1. GHG emissions from the Tbilisi Transport sector (Gg CO2 eq.) in 2009 and 2014 according to monitoring results and baseline scenarios (არმაქვს)

As it comes from the inventory results, the 2014 emissions compared to the revised baseline scenario are reduced by about 83.4 Gg, being 4.7% of Transportation sector's baseline emissions.

2.3. Emissions Reduction Measures Implemented in the Tbilisi Transportation Sector

In 2010-2014 a number of measures have been implemented in Tbilisi Transportation sector aimed at optimizing the public transport and improvement of road infrastructure. According to estimations, these measures resulted in the reduction of emissions by about 90 Gg, being 17.8% of planned in this sector cutback. The difference between emissions reduction obtained under the inventory outcome (83.4 Gg) and resulting from taken measures (90 Gg) is sufficiently small and is caused by other external factors not envisaged in these measures (which weekend their effectiveness).

In the Table below the measures planned till 2014 in the Tbilisi SEAP are listed and the status of their implementation is defined (Table 16).

The assessment of saved energy and relevant reduction of emissions are given inTable 17.

Table 16. Implementation status of measures in the Tbilisi Transport sector

Sector	Major activities	Area of intervention	Tool	Initiator of activity	Responsible agency	Implementing period		Realization status	Spending Up to this stage (GEL)
Transport						**start**	**end**		
Activity MF1	Renovation of municipality vehicle fleet	Clean/efficient vehicles	N/A	Local authority	Tbilisi City Hall administration	2011	2011	Accomplished	ესცხრილია რმაქვს, ამობეჭდი ლვარიანტშ იარჩანსციფ რები
Activity PR 1	Setting up of traffic lights control center	Optimizing road network	N/A	Local authority	Tbilisi City Hall Urban Transport Service	2011	2020	Current	
Activity UP1	Improving the road infrastructure	Optimizing road network	N/A	Local authority	Tbilisi City Hall Transport and infrastructure Urban Services, Tbilisi Development Fund	2010	2015	Current	
Activity PB1	Public transport popularization campaign	Transfer to public transport	Awareness raising	Local authority	Tbilisi City Hall administration/ Public Relations and Marketing Dept. of Tbilisi Transport Company / Media companies	2010	2020	Current	
Activity PB2	Improving public transportation services	Transfer to public transport	Transport regulation	Local authority	Tbilisi City Hall Urban Transport Service / Tbilisi Transport Company/ Media companies	2010	2020	Current	
Activity PB3	Other ways of public transport improvement	Clean/ efficient vehicles	Transport regulation	Local authority	Tbilisi City Hall Urban Transport Service / TTC	2011	2015	Current	

Activity PR2	Carrying out measures to restrict private cars traffic	Transfer to public transport	Different	Local authority	Tbilisi City Hall Urban Transport Service	2015	2020		
Activity PR3	Encouraging low emission vehicles	Clean/ efficient vehicles	Different	Local authority	Tbilisi City Hall Urban Transport Service	2015	2020		
Total									

Table 17. **Saved energy and reduced emissions resulting from taken measures**

		2014 monitoring results		Assessments for 2020 according to 2011 SEAP	
Sector	**Major**	**Energy Saving resulting from the measure**	**Reduction of CO2 from the measure**	**Saving of energy resulting from the measure MWh/yr.**	**Reduction of CO2 from the measure (t/yr.)**
Transportation					
Activity MF1:	Renovation of municipal vehicle fleet	4 832.61	1 257.67	3 960.00	990.00
Activity PR1:	Setting up of traffic lights Control Centre			491 060.00	123 850.00
Activity UP1:	Improvement of road infrastructure			30 980.00	5.47
Activity PB1:	Public transport popularization campaign	63 000.00	14 000.00	137 690.00	30 540.00
Activity PB2:	Improvement of public transport services	278 207.68	74 274.95	183 590.00	40 720.00
Activity PB3:	Other ways of public transportation improvement	2 614.00	561.00	306 050.00	69 180.00
Activity PR2:	Introduction of measures restricting private cars traffic			271 750.00	60 500.00

Activity PR3:	Encouragement of low emissions vehicles			669 520.00	179 400.00
Total		**348 654.29**	**90 111.62**	**2 094 600.00**	**505 185.47**

Description of Actions

Action MF1 (M1) – Renovation of municipal vehicles (serving cars) fleet

In 2011 Tbilisi City Hall has purchased from the company "KIA Motors Georgia" Ltd. 210 units of new cars and handed over old cars owned by the City Hall. The majority of obtained vehicles were small-capacity Kia Picanto cars. Table 18shows the types, number and fuel consumption of new vehicles acquired in 2011.

Table 18. **Municipality serving cars purchased in 2011**

Vehicle type	Number	Fuel consumption per 100 km
Kia Picanto 1.0	122	4.4
Kia Rio 1.4	23	4.6
Kia Optima 2.0	18	7.6
Kia cerato 1.6 (Mechanical)	37	6.5
Kia cerato 1.6 (Automated)	5	7.5
Kia sportigi 2.4	2	9.4
Kia cadenza 3.5	1	9.5
Renault Logan Van	1	7.5
Mitsubisi L200	1	10.6
Total	**210**	

Total cost of cars made 4 139 490 GEL, from which part of the cost was covered by the City Hall at the expense of handed over / commissioned old cars.

As a result the average fuel consumption on 100 km per one car has decreased, but the vehicle annual run has increased. In spite of this the summary fuel consumption nevertheless has downsized. In 2014 the City Hall serving cars all in all have consumed 790 093 liters of gasoline and 40 663 liters of diesel, in total 7 703 MWh of energy. Corresponding emissions from this amount of fuel equal to 1 925 t CO_2 eq. (see Table 11). Compared to 2009 the energy consumption has been lowered by 3 992 MWh and the emissions – by 1 059 tons. According to the updated baseline scenario in 2014 energy consumption by this sector made 12 539 MWh with corresponding emissions of 3 201 ton. Consequently, corresponding to baseline scenario the energy consumption is curtailed by 4 832 MWh while the emissions are cut by 1 276 tons.

Action PR1 (G1) – Traffic Lights Control / Management Center

Since 2012 the Traffic Lights Control Center is functioning in Tbilisi being an automated traffic management system (Traffic Control and Management Center) providing the collection of

information on the parameters of transportation flows, it's processing and based upon this data – the regulation of traffic currents in the optional regime.

The control system has its peripheral equipment –transport controllers and detectors. The automated system is controlled from the control panel located at the M. Machavariani street (the 112 building).

The connection of traffic lights to the Control Center was conducted gradually. At present 121 traffic lights are linked with the control panel (Chavchavadze Ave., Paliashvilist., Abashidzest., Vazha-Pshavela Ave., Al. Kazbegi Ave., Mitskevichist., Tsintsadzest., A. Tsereteli Ave., David Curamishvili Ave., Sarajishvili Ave., Dadianist., Eristavist., KetevanTsamebuli Ave., LekhKachinskist., Moscow Ave.).

The function of peripheral equipment is: Assessment of primary information on the parameters of traffic flows; Execution of order from the Control Center; Formation of telemetric signal on the execution of order and it sending to the Control Centre; Providing of traffic light operation in local regime in case of communication break with the control panel.

Using the traffic lights joined to the traffic automated system it is possible to manage automatically the traffic on the relevant streets and freeways. The automated alteration of traffic light's operation modes (regulation cycle, phase, stroke) allows to reduce to the maximum extent traffic jams, delays at the crossroads, traffic accidents. One of the most important functions of the mentioned system is the coordinated operation of traffic lights (the "green wave").

Total amount of expenditures spent in 2011-2014 on the "installation" of 121 traffic lights and arrangement of traffic control system in the frame of the project implemented in Tbilisi (including video panel mounted in the 112 building, computers and servers) made 13 316 654 GEL.

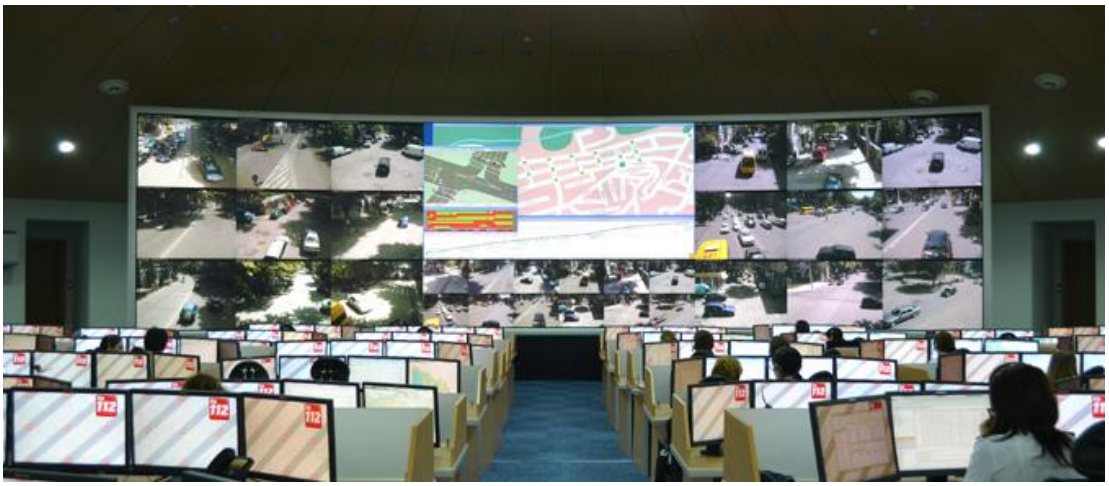


Figure 6. **Tbilisi traffic lights control center**.

The realization of GHG emissions reduction potential related with the traffic management (as well as the improvement road infrastructure) is a complicated and contradictory process. The reduction of traffic congestion will decrease GHG emissions from individual vehicles as they will be able to run more efficiently, but this could not necessary bring the lessening of total

emissions because the cutback of overloading causes the possibility of running more cars. The moderate speed moving vehicle may be more efficient than the vehicle running in the "stop-start" regime, though the smooth driving may cause the increase in the number of moving cars finally resulting in the net growth of emissions. Hence, if the decrease in the traffic congestion will be accompanied with the restrictions in the use of private cars, the discounting of GHG emissions may be achieved in reality. Mindful of this, the discussed above measures and related emissions reduction could be regarded as a part of broader transportation strategy along with other measures described in this document. The effectiveness of these activities has been assessed for the private transport (including private passenger taxi and commercial). According to 2014 monitoring results the energy consumption in this subsector made 6 876 GWh, and emissions equaled to 1 607 Gg CO_2eq. In the updated baseline scenario the energy consumption in this subsector in 2014 was 6 311 GgWh with subsequent emissions of 1 610 Gg. Accordingly, compared to the baseline scenario the energy consumption is increased (conditioned by the transfer to the less efficient gas) and emissions are decreased by only 3 Gg. Consequently it could be resumed that these measures have not resulted in emissions reduction yet. However, at this point there is significant uncertainty in relation with the number of taxis and it is important to provide for the follow-up monitoring more precise accounting of the number of taxis and relevant improvement in accuracy of the inventory. No less valuable is to examine and amend the features of commercial transport's movement to secure the correct calculation of this activity results.

Action UP1 (G2) – Improvement of road infrastructure

In 2009-2014 a number of measures have been undertaken aimed at the planning of new streets and construction of connecting roads and tunnels for the unloading of the traffic and shortening of routs. These are:

- Intense traffic road (MukhranMachavarianist.): this road offers 2 km shorter route to travel from the Agmashenebeli Movement in the direction of Saburtalo district;
- New road from the Heroes Square (ChabuaAmirejibi Freeway): A new 3km long highway has been constructed from the Heroes Square to the Tamarashvili streets, passing 2 800 cars an hour in one direction. The arrangement of this road has significantly unloaded the Chavchavadze and Beijing-Vazha-Pshavela-A.Kazbegi freeways. It has to be noted that the June 2015 flooding has seriously damaged this highway, as a result of which as of August 2015 traffic on this road is impossible;
- Gelovani-Agmashenebli tunnel: In 2011 at the crossroad of Marshal Gelovani and David Agmashenebli Alley the tunnel has been constructed to regulate and unload the traffic (with 2-line traffic from Gelovani to Agmashenebli Alley), which allowed the transport to move freely in any direction without traffic light regulation;
- In 2014 a new 600 m long road was built connecting the Sheshelidze and Gabronidze streets, which allowed the vehicles riding from Sheshelidzest. to Mukhiani Settlement to move freely in the Mukhiani – Temka direction bypassing

the Metro Station Akhmeteli and the Theatre. This road has considering discharged the Metro Station Akhmeteli surrounding territory.

Some other measures, not included in the Plan, have been implemented as well. Among the:

- At the right embankment of R. Mtkvari between the Queen Tamar and Baratashvili Bridges a number of activities have been undertaken including: 1) Two overpasses were constructed in the vicinity of Laguna Vere in 2 direction – to the Dighomi District and the Heroe's Square; 2) The driving part has been widened at the expense of sidewalk on the HeidarAliev embankment (one line was added from the Dry bridge to the Galaktioni Bridge; 3) Near the Galaktioni Bridge from Queen Tamar Bridge to the Baratashvili Bridge the tunnel and overpasses were constructed allowing the unimpeded traffic in this direction, as well as from the Baratashvili Bridge to the Queen Tamar Bridge; 4) In the environs of Baratashvili Bridge and the House of Justice an overpass has been constructed allowing free drive from the Baratashvili Bridge to the Queen Tamar Bridge; 5) The unmounted bridge has been constructed for pedestrians allowing free traffic in this area without traffic lights regulation;
- In 2014 in the vicinity of loaded Metro Station Sarajishvili an overpass has been constructed connecting the Sheshelidze and Sarajishvili streets. It made possible to ride freely from Sheshelidze to the Avchala Settlement and the Kerchi street;
- The Tbilisi Sea Circular Road rehabilitation works have been undertaken (major repairs of the road, mounting of safety fences). The rehabilitation of 10-km Circular Road facilitated the unloading of Tbilisi central freeways. The road is used by vehicles driving from the Gldani – Nadzaladevi District to the Varketili and Lilo Settlements and vice versa.

As at this stage no notable reduction in the fuel consumption and emissions from private sector in comparison with the baseline scenario (see Measure G1), it could be said that no significant decrease of emissions by this measure is not achieved.

Action PB1 (Y1) – Public transport popularization campaign

In 2010-2014 the Tbilisi Transport Company (TTC) was actively engaged in the public relations (PR) campaign, including the following activities:

- Improvement of Company's services and introduction of new products;
- Efficient delivery of information to the passengers on innovations and changes taking place in the Company;
- Carrying out of different qualitative surveys, aimed at gathering information on the attitude of passengers to specific items, the analysis and response to this data. In this respect an important part is played by the Company's "Hot line", which registers the remarks and claims of consumers;
- Intensive preparation of materials on different topics to raise the awareness of company personnel and general public on activities and processes going on in the Company.

As it was mentioned above, the residents and guests of Tbilisi already are using the Transportation website (http://ttc.com.ge/), which allows to plan the trip, find the schedules, and watch in real time the movement of the buses, use the SMS service for defining the arrival

of the bus at any stop/station. As to the shuttle taxis schedules, they could be found at the "Tbilisi Minibus" website: http://tm.ge/routes/site.php.

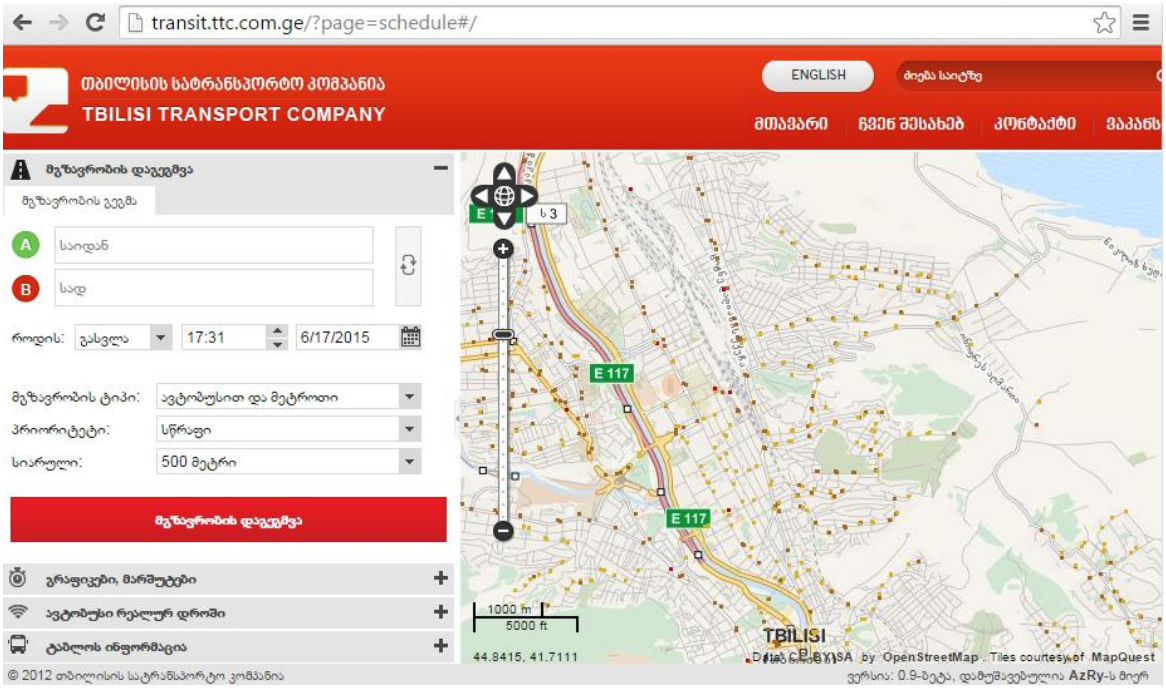


Figure 7. Planning of the route with the TTC website.

Besides, the TTC has completed in 2013 the integration in the Google system (Google Transit) of information on the routes, stops and schedules of Tbilisi Metro and buses. For some months this service was tested by the Google that was conditioned by the strict high standards policy of Google. The Google-transit is a part of Google Map project which allows the customer to plan a trip using the public transport. All developed cities of the world are involved in this project and from the beginning of 2014 Tbilisi has joined the list of these cities.

For setting up Transport Company's website in March 2012 two competitions were announced:

- Creation of trip planning program – 14 160 GEL;
- Creation of website design – 15 000 GEL;

The tender for setting up of SMS service software was announced in August 2012, providing 7 000 GEL.

For the integration in the Google system of information about routes, stops and schedules of Tbilisi Subway and buses the Trip Planning Programme has been used, followed by one year active cooperation with the Google of TTC Information Technologies Service aimed at superimposing of mentioned information on the Google Map without paying additional cost by the Company.

In 2010-2014 the advertisements were broadcast on different TV channels, providing the passengers with the following information:

- On the introduction of new system of paying transport fees in the municipal transport (getting and using of Metromoney cards);

- On the system of discounting fees in the public transport;
- On the improvement of passengers ticketing in municipal buses (the campaigning format);
- On the temporary blocking of some central streets or alteration of bus routes during celebrations or holidays (information lips);
- On the free trips on holidays declared by the City Government (New Year, Easter, Christmas, etc.).

At the same time topics and documental were prepared by a number of TV channels, press and Internet portals about the municipal transport (mainly on Tbilisi Subway).

Under the order of Tbilisi Hall the advertisement campaigns were conducted in 2013-2014 for the TTC aimed at the demonstration of Company in the youth education programs, costing 55 880 GEL.

The effectiveness of this activity could be assessed by the increase of public transport customers, demonstrated in theTable 5. According to baseline scenario this increase in 2014 was to be about 25%, but actually it made 34%, consequently leading to the cutback of energy consumption in the Transport sector by 63 GWh and emissions reduction by 14 tons[25].

Action PB2 (Y2) – Improvement of Public Transport Service

Different measures have been undertaken to improve the public transportation services, among them:

- **Electronic displays**. In 2011 the Tbilisi City Hall started the mounting at the bus stops of modern electronic displays. At present 938 electronic displays are operating in the capital city (initially 950 displays have been installed from which 12 units were damaged). The display allows the passenger to define exactly the arrival time of the necessary route bus and accordingly plan the trip. Electronic displays operate in the online regime and inform the passengers with absolute accuracy on the arrival time of desired bus. The cost of this highly comfortable undertaking realized in 2011-2014, made in total 2 383 145 GEL.
- **New comfortable mini-buses**. In summer 2011 the new "Ford Transit" type mini-buses (equipped with Euro-4 engine) have arrived in Tbilisi. Their services are much better compared to previous ones, but their overloading creates problems which require new planning. The Tbilisi City Hall did not make investments in this direction though the investments by private companies makes about 44 million EURO.
- **Flexible and preferentialpay system**. The travel cost can be paid in any public transport using the Metro-money universal plastic card, initially issued in 2006 solely for the use in Subway. Since 2009 its utilization became possible in buses, from 2011-in mini-buses and since 2012 – in cable-car. The city is rich in plastic cards automatic chargers to simplify the filling process. At present the passengers transportation by public transport is regulated with the City Assembly 30 December 2014 Decree N20-81. The 90 minute privilege / free travel was approved by the City Assembly 27 July 2012 (N 8-30) and came into force 01 August 2012.

[25] Calculation are performed using the LEAP model

- **Safe transportation**. Drivers hired by the TTC, before being allotted to the concrete rout, pass special theoretical and practical training. At the same time the Company provides annual check-up of their health in the frames established by the Low. The safety of mini-bus passengers is protected by operating companies as well as the Transportation Urban Service (Tbilisi City Assembly 30 December 2014 Decree N 20-82). The technical state of vehicles, according to the Low of Georgia on the Road Traffic, is checked twice a year by the Ministry of Internal Affairs Service Agency at the special Maintenance Stations. Besides, daily, after returning from the route, the vehicle undergoes a technical check-up. As to the keeping of traffic rules by the drivers, it is controlled by the Patrol Police.
- **Improvement and optimization of routes**. The design of bus and mini-bus route schemes is determined by the Urban Transport Service. This design is compiled on the basis of population requests' examination and consideration of main passenger flows and traffic safety, being finally presented to the city Government. The decision taken by the City Hall further is submitted to the City Assembly for the follow-up discussion and approval. As it has been mentioned above, the optimization of routes has been enacted in 2010-2014. In particular, till autumn 2009 the 124 bus routes were functioning with 749 daily operating buses. The total number of buses made 932 (among them 241 the "DAF" buses). At present the number of routes has decreased to 97 with 511 daily operating buses. Total listed number of buses equals to 579. As of 2009 the number of shuttle mini-bus routes amounted to 226 and the total number of mini-buses overpassed 3 000 vehicles. To 2015 the number of routes was to reduce to 191 and the number of mini-buses-to 2 000 cars.

In addition to listed above measures the **arrangement of special bus transit lines** was planned to become operational in 2015. This measure is in force up to now.

The discussed above measures are aimed at simplifying the use of public transport and creation of comfort, raising the level of public transport employment. This effect has already calculated in the frame PB1 Activity. At the same time, this activity includes the optimization of vehicle fleet and routes for mini-buses and buses. In 2014 buses and mini-buses have consumed in total 313.7 GWh of energy, correspondingly emitting 82.5 Gg CO_2 eq. (see Table 12). Compared to 2009 the consumption of energy has decreased by 160.2 GWh and emissions have lowered by 42.9 Gg. According to the updated baseline scenario in 2014 the energy consumption for this kind of transportation equaled to 591 GWh and the emissions – t 156.8 Gg. Accordingly in comparison with the baseline scenario the energy consumption has downsized by 278.2 GWh, while the emissions have been cut by 74 Gg CO_2 eq.

Action PB3 (Y3). Other ways of improving public transportation services

- **Optimization of the bus fleet.** Big and fuel intensive buses were to be removed from the fleet. In 2010 the absolute 241 "DAF" buses were withdrawn from the fleet reducing the energy consumption and emissions. The effect of discounting number of buses has already calculated under the Activity PB1.
- **Extension of Subway to the University Station.** This measure was planned for 2013-2014 but it has not implemented yet. However the fulfillment of this action has

already started. In 2015 related with the construction of University Station the Municipal Development Fund has announced the tender. The financial support is provided by the Asia Development Bank. The competition has been won by the Spanish companies "Cobra Instalaciones Y Servicios, S.A" and "AssigniaInfraestructuras, S.A". The cost of this undertaking equals to 83 000 670 GEL. According to contract terms the works should be terminated in 630 days from the beginning of construction. The assumed commencement of works is scheduled for the end of July 2015, resulting in termination of the project in March 2018.

- **The Tram Line.** This planned project has not implemented yet, however the funicular tram has been put into operation bringing emissions reduction as well because this tram, apart of tourists, is widely used by local population substituting the road transport. In particular, this tram line shortens the road transportation by 5 km. According to 2014 data the funicular tram has been used by 639 387 passengers consuming 645 MWh electric energy with corresponding 258 tons of emissions. In case of using by these passengers the road transport instead of tram (assuming gasoline powered car with 2 passengers on board), the energy consumption would be equal to 3 241 MWh and emissions 807 tons. Consequently, the 2 596 MWh of energy has been saved and 554 tons of emissions reduced (in case of using electricity grid average emission factor, the emissions reduction goes up to 740 t CO_2 eq.).

Besides, since June 2012 the Tbilisi public transport was added with the Rike Park – Narikala Fortress cable car. In contrast to the funicular tram line, this cable-car is mainly oriented on serving the tourists and is not regularly used by city population. Hence, emissions reduction from its operation is not significant.

At the same time a measure has been undertaken consisting of replacing loss efficient lamps with LED bulbs in Tbilisi Subway rolling-stock. In 2013-2014 during the renovation of metro carriages the ЛБ-20 luminescent lamps were substituted by LED lamps. Bulbs were replaced in 20 wagons and 860 lamps were substituted in total with 11 520 LED cells. Actually, the equivalent of 1 old ЛБ-20 type bulb is 13 LED cells.

The capacity of ЛБ-20 bulb is 20 W, while that of equivalent LED cells – 14 W. The aggregated capacity of old bulbs comprised 17.2 KW and that of new ones – 12.2 KW. The daily duration of lighting in carriages is one the average 10 hours, correspondingly the annual saving of energy makes (17.2-12.2) x10x365 = 18 250 KWh and relevant reduction of GHG emissions by 7.3 tons.

Apart of efficiency, the preference of LED cells consists of safety, ecological cleanness and reliability.

In 2010-2014 span 63 wagons have been repaired costing in total 39 816 037 GEL.

All in all, since 2014 in the frames of Activity PB3 2 614 MWh of energy has been saved with related emissions of 554 tons.

The discussed above measures were planned in the Tbilisi SEAP for 2010-2014. At the same time, in the long-run perspective (beginning from 2015), the **Action PR3 (R1) "Private Cars Discouraging Actions"** was envisaged, defined under the long-term strategy. It included measures related with pricing policy for transportation in the center of the city,

arrangement of Environmental Islands and the parking policy. No emission reduction activities in these directions were not undertaken in 2010-2014.

Despite the fact that the parking in Tbilisi is managed, the measures directed towards the reduction of emissions (decrease in parking places, substantial increase of parking cost) have not been implemented. As at this stage there is no significant decrease in parking sites (see Table 1) and considerable rise in parking costs, it has been considered that this measure does not initiate the discounting of emissions.

The implementation of **Activity PR4 (R4) – Encouragement of Low Emission Cars** has been planned as well. It was expected that technical control of motor vehicles would become mandatory beginning from 2015, facilitating the adaption of various stimulant measures, e.g. the replacement of highly polluting gasoline and diesel driven cars with environmentally clean vehicles. This was to be supplemented by the introduction of other environmentally friendly measures such as establishment of low or zero fees on parking for environmentally clean vehicles, low tariffs for their technical control, discounting tariffs for taxi drivers operating low-emission cars, etc.

The mandatory technical control of vehicles has been postponed till 2018 and thus other measures in this direction were not implemented.